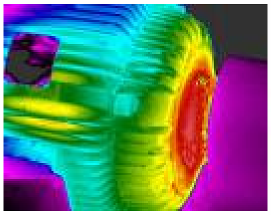
MOTOR CONTROL CONTACTORS AND BREAKERS AND SWITCHES

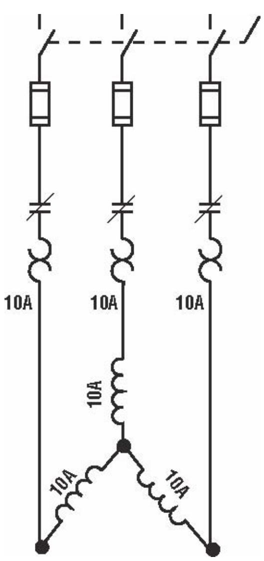


Bad contacts or poor connections are the cause of failure or poor performance in a wide variety of electrical devices. For example, corroded jumper cable clamps can frustrate attempts to start a diesel generator , even with a good battery, dirty or corroded contacts on a fuse or its holder can give the false impression that the fuse is blown or can cause the fuse to blow, not from excessive current, but excessive heat at the high resistance connection.. A sufficiently high contact resistance can cause substantial heating in a high current device such as a fire pump, main circ. pump, jacket water cooling pumps. Unpredictable or noisy contacts are a major cause of the failure of electrical equipment. An **intermittent contact** which alternates rapidly between a high and low resistance is the worst nightmare of anyone who has to troubleshoot equipment. Motor controller poor terminal connections have an extra dimension. The high resistance motor lead in the motor controller will also cause single phasing of the motor windings. The added in line resistance of a poor crimp lug-compression lug fastener or loose terminal adds a new dynamic of motor winding current displacement, decreased power factor, decreased motor torque/horsepower. 44% of motor failure problems are related to HEAT. Allowing a motor to reach and operate at a temperature 10°C above its maximum temperature rating will reduce the motor’s expected life by 50%. Operating at 10°C above this, the motor’s life will be reduced again by 50%. This reduction of the expected life of the motor repeats itself for every 10°C. This is sometimes referred to as the “half life” rule. Most motors should last around 20 years if given a little maintenance attention periodically.

Voltage Unbalance

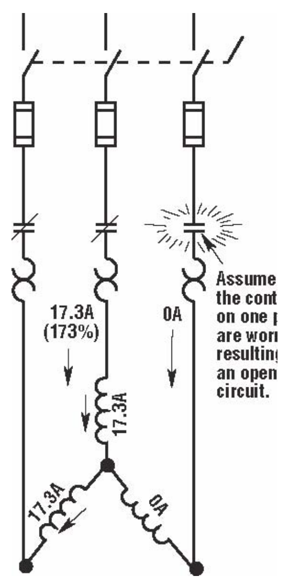
When the voltage between all three phases is equal (balanced), current values will be the same in each phase winding.

The NEMA standard for electric motors and generators recommends that the maximum voltage unbalance be limited to 1%. When the voltages between the three phases (AB, BC, CA) are not equal (unbalanced), the current increases dramatically in the motor windings, and if allowed to continue, the motor will be damaged.



Hazards of Secondary Single-Phasing for a Three-Phase Motor

When one phase of a secondary opens or partially opens or has a high resistance, the current to a motor in the two remaining phases theoretically could increase to 1.73 (173%) times the normal current draw of the motor. The increase can be as much as 2 times (200%) because of power factor changes. Where the motor has a high inertia load, the current can approach locked rotor values under single-phased conditions.



So what does this have to do with me, or “My thermographer will find the “Hot-Spots”

Thermography can find the hot spots with motors, but by now, if you read and not skipped reading most of the paper, you understand, ensuring you understand the true import of the finding has more to do than with “just maybe tightening and cleaning a connection.”

If a motor has had a loose terminal connection in the controller or “T’ box on the motor, of course, clean and tighten. However, if you have been keeping good meggar readings on this motor, you may have found the megohm readings decreasing. This suggests that the motor has had a voltage imbalance or increased current for a while now, and the insulation is deteriorating or dielectric strength of the insulation is on its way out.. This could indicate a “dip and bake” to insure that the anticipated life of the motor is realized, not just tightening a loose lead.

Also, if the motor is suspected to have had a loose connection for a while, a MCA “motor circuit assesssement of the windings could be valuable. We at SEA use a instrument that reads the phase angle of the windings, power factor and impedance of the individual winging to find partial shorting between phases due to single phasing or phase imbalanced and increased motor currents. However, a good LCR meter, used properly can check the inductance of the windings to help determine motor issues. Also eccentricity of the rotor can be determined, if done correctly.

Milli Volt Drop Test

NETA states Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar bus by more than 50 percent of the lowest value.

The electrician or et or engineer can also test breakers, switches, fuse holders, contactors by using a multimeter that reads at the millivolt level. This a great test for also determining poor connections or pitted or dirty mating surfaces. If after cleaning the connections or redoing the lug assemblies and the voltage drop of the breaker or contactor has not dropped, then a new one should be on order.

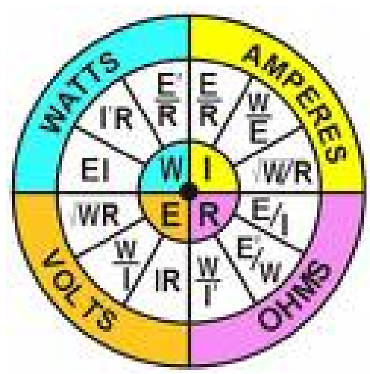
Do not use a multimeter ohms scale to read across contacts. The multimeter leads have enough resistance to cause erroneous readings. If you wish to do a milliohm test of contacts or motor leads, then use an appropriate milliohm meter or wheaststone bridge device.

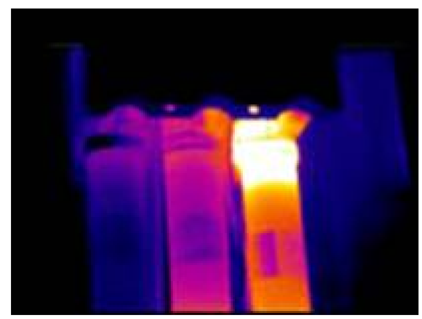
It is my hope that the information presented in small way introduce you to understanding that many times, just tightening a connection does not eliminate the prior damage done. In some cases, like loose connections on lighting circuits, tightening solves the issue and saves the day from a class “Charlie” fire.

Best Regards,

Ben Holt

Master Thermographer
CEM Certified Energy Manager/P.Q. Analyst
Motor-Gen. Condition Analyst
Systems Energy Audit Company, Inc.
Manager of Infrared/Power Quality Services
Marine-Industrial-Commercial-Hydro Electric Plants
Small Business Disabled Veteran Business Enterprise Certified
phone/fax (619) 265-1901
Email: pwrqual@cox.net
Web: www.irsurvey.com





finding & fixing problems before they happen